ScienceFest

Ft. Lauderdale

10th National Clean Cities
Conference and Expo
May 2–5, 2004

STUDY GUIDE

Florida Gold Coast
Clean Cities Coalition

BROWARD COUNTY
FLORIDA

**Hosted by the Department of Energy,
Office of Energy Efficiency and Renewable Energy,
Broward County Air Quality Division and
the Gold Coast Clean Cities Program**

Dear Teachers:

Thank you for your participation in ScienceFest 2004. We are working hard to ensure that this is a valuable learning experience for your students. To assist you in preparing your class for the event, the ScienceFest committee has developed this study guide. The *ScienceFest Study Guide* provides background information on topics related to those that will be presented at the scheduled ScienceFest sessions.

The study guide has been organized into three major topics: Energy, Ecology and Physics. Each topic provides a summary of important concepts that students should be familiar with to maximize the educational benefits of ScienceFest. We hope that you will find the information useful and interesting, and look forward to seeing you at the May 5th event.

Sincerely,

Cynthia Corbett-Elder
ScienceFest Chair

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Concurrent Session Guide

Hydrogen Fuel Cell Technology, presented by the Department of Energy

What's the buzz about hydrogen? Through a hands-on activity, students will learn about the concept of a "hydrogen economy," how fuel cells work, and how hydrogen and fuel cells will fundamentally change the way we produce, store, and use energy. Students will learn about the safe use of hydrogen - what may really have happened to the *Hindenburg* - and how they can help our country move toward a hydrogen energy future.

SC.B.1.3.1, SC.G.2.3.1, SC.H.1.3.6, SC.H.3.3.4, SC.H.2.3.1

NASA, Hydrogen, and You, presented by NASA

Sure NASA is the Space Shuttle and the Space Station, but it is much more than that. NASA's Mission is: "Understanding and protecting our home planet; exploring the universe and searching for life; inspiring the next generation of explorers, as only NASA can." This includes developing advanced aircraft and aero propulsion, Earth observing satellites and interplanetary probes. This session will focus on just a piece of the NASA picture: NASA's activities using hydrogen as a rocket fuel and for fuel cells. These activities and the associated technology development helped set the stage for our society's use of hydrogen as a clean fuel for automobiles and electrical power.

SC.B.1.3.1, SC.G.2.3.1, SC.H.1.3.6, SC.H.3.3.4, SC.H.2.3.1

Solar Energy, presented by the Florida Solar Energy Center

The sun is an inexhaustible, pollution-free source of quiet, safe, energy. Photovoltaic cells produce electricity directly from solar energy. This solar energy can be used to charge the batteries of an electric car or power a solar car directly. Also, solar energy can be used to generate hydrogen for fuel cell cars. The theory, application, and components of solar energy generation systems used for transportation will be presented to students.

SC.B.1.3.1, SC.G.2.3.1, SC.G.2.3.2, SC.H.3.3.4, SC.H.2.3.1

EnviroScape, presented by the South Florida Water Management District

The Everglades is a globally unique ecosystem supporting a vast array of plant and animal life. It has molded the regional charactor of central and southern Florida and sustains the economic and cultural growth of the region by contributing to Florida's water quality, water supply, flood control, recreation and aesthetics. Through demonstrations with the EnviroScape model, students will learn about the importance of wetlands in protecting lakes, rivers and bays, and in providing flood protection.

SC.B.1.3.3, SC.D.2.3.2, SC.G.2.3.2. SC.G.2.3.3, SC.G.2.3.4

Energy Transformations, presented by the Museum of Discovery and Science

Electricity is everywhere in nature, even in our bodies. All electricity producing devices simply rearrange charges that were already there into a more useful configuration. This session will introduce the relation between magnetism and electricity and then let students move magnets over various coils and see the needle on the meter move as electricity is produced. This will be followed by a short introduction to more exotic methods such as thermocouples and piezoelectric materials. Students will be able to see a thermocouple in action as well as see and feel the spark produced when the piezo crystal is deformed.

SC.B.1.3.1, SC.B.1.3.4, SC.G.2.3.1, SC.H.2.3.1

Recycling, presented by Broward County's Office of Integrated Waste Management

Reduce, reuse, and recycle. Choose to be part of the solution by learning to protect the environment. Students will discover how trash is turned to treasure in the movie *All About Garbage*. They'll learn about energy transfer in a discussion on Broward County's Waste to Energy plants. You will never look at trash the same way again!

SC.B.1.3.3, SC.D.2.3.2, SC.G.2.3.1, SC.G.2.3.4

Mad Science®, presented by Mad Science South Florida

Learn about electricity, pressure, alternative forms of energy and space exploration in this workshop presented by the world's largest children's science education and entertainment company. Using diffraction glasses and hands-on experimentation, students will learn about Newton's Laws and the white light spectrum. Demonstrating the properties of alternative fuel sources, presenters will excite and entice young minds toward future developments in this important sphere of science exploration.

SC.B.1.3.1, SC.C.2.3.6, SC.H.2.3.1

ENERGY

Fueling Our Demands

Standard 2, Benchmark SC.A.2.3.3
Standard 2, Benchmark SC.D.2.3.1
Standard 2, Benchmark SC.B.2.3.2
Standard 2, Benchmark SC.G.2.3.1

Energy & You

Energy is one of the most fundamental parts of our universe. We use energy to do work. Energy lights our cities. Energy powers our vehicles, trains, planes and rockets. Energy warms our homes, cooks our food, plays our music, gives us pictures on television. Energy powers machinery in factories and tractors on a farm. Energy from the sun gives us light during the day. It dries our clothes when they're hanging outside on a clothes line. It helps plants grow. Energy stored in plants is eaten by animals, giving them energy. Predator animals eat their prey, which gives the predator animal energy. Everything we do is connected to energy in one form or another.

Energy is defined as: "the ability to do work." Work means moving something, lifting something, warming something, or lighting something. But where does energy come from? There are many sources of energy including:

- Electricity
- Biomass Energy - energy from plants
- Geothermal Energy
- Fossil Fuels - Coal, Oil and Natural Gas
- Hydro Power and Ocean Energy
- Nuclear Energy
- Solar Energy
- Wind Energy

Photo credit: corbisimages.com

Source: Foundation for Water and Energy Education

FUN FACTS

Energy can take on different forms such as mechanical, chemical, or nuclear. Furthermore, one form of energy can be transformed into other forms. For example if you were to jump, your body would transform the **chemical** energy stored in the food you eat into the **mechanical** energy of jumping.

Activity: **Energy Transformations**

Objective: To identify the energy transformations that occur during the production of energy for human use.

Directions: Review the worksheet "Forms of Energy" on page 6 and complete the "Energy Transformations" worksheet on page 7.

Source: Museum of Natural Science, From Fossil Fuels to Future Fuels Discovery Kit

Energy is...Forms of Energy

NUCLEAR ENERGY is the energy locked in the nucleus of the atom. It is the force that binds the nucleus of the atom together. This energy can be released in two ways, fusion and fission. Fusion is the process of fusing, or combining, atoms into heavier atoms. This process takes place in the sun's core when hydrogen atoms combine to form helium, a heavier atom. When atoms are fused, a lot of energy is given off in the form of light and heat. Scientists here on Earth haven't learned how to replicate fusion, but they can produce nuclear energy by fission. Fission is the process of splitting atoms to make simpler atoms. When atoms split, energy is released. Nuclear power plants produce energy by splitting uranium atoms.

RADIANT ENERGY is energy that travels in waves. The radiant energy we know best is light energy. It helps us see by wiggling the receptors in the back of our eyes, and we use it all the time. But light isn't the only form of radiant energy. Radio and television waves are also radiant energy, but they are less powerful than light waves. X-rays and gamma rays are more powerful than light waves - they can pass through skin, bones, and several feet of concrete.

CHEMICAL ENERGY is the energy that is stored in things like fossil fuels, wood, and the food that we eat. When molecules bond together to make compounds, energy is stored in the bonds. When the compounds are broken down into simple molecules (when we burn gasoline or digest our food), the energy stored in the bonds is released. Millons of years ago, tiny plants living in the ocean used energy from the sun to bond molecules together to make the sugars and other compounds they needed to grow. When these plants died they sank to the bottom of the ocean, taking energy with them. Over time, many layers of sediment buried the plants deeper and deeper under the ground. Heat and pressure "cooked" the plants and changed them into oil and natural gas. When natural gas is burned, it is changed into carbon dioxide and water. Some of the energy the plants got from the sun and stored in chemical bonds is released as heat and light.

MECHANICAL ENERGY is the energy of motion and of position. An object that is moving has energy. The faster it moves the more energy it has. This energy of motion is called kinetic energy. An object can also have energy because of its position - this is called potential energy. A rock resting at the top of a hill has potential energy. The higher it is, the more energy it has. Once the rocks starts rolling down the hill, some of its potential energy becomes kinetic energy. When it reaches the bottom, all of its energy is kinetic energy. The sum of an object's kinetic and potential energy is its mechanical energy.

THERMAL ENERGY, or heat, is a special kind of kinetic (motion) energy. It is the energy of moving or vibrating molecules. The faster an object's molecules move or vibrate, the hotter the object becomes. The hotter an object is, the more thermal energy it has. Thermal energy always travels from hotter objects to colder objects - never cold to hot. For example, when you put an ice cube into a hot drink, the "cold" from the ice cube doesn't go into the drink. Instead, some of the thermal energy in the hot drink is used up to melt the ice cube (give it more heat.) Because the hot drink lost some of its thermal energy, it feels cooler.

ELECTRICAL ENERGY is a special kind of kinetic (motion) energy. It is the energy of moving electrons. Lightning is an example of electrical energy - billions of electrons travel from a cloud to the ground. Electrical energy is always produced by one of the other forms of energy. We can transform the chemical energy stored in a battery or the mechanical energy of a turning windmill and produce electicity. We use electrical energy to perform lots of tasks. We make light, produce heat on a stove, keep our food cold, and operate motors.

Source: Houston Museum of Natural Science, From Fossil Fuels to Future Fuels Discovery Kit

Energy is...Energy Transformations

Directions:

Fill in the blanks with the appropriate form of energy represented at each stage in the energy transformation.

Inside the sun's core, four hydrogen atoms fuse to form one helium atom. This process produces a tremendous amount of energy.

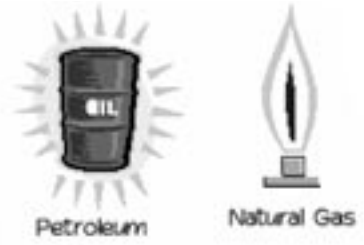
_____

Some of this energy is given off as light (some as heat). Light travels in waves through space. Some of it reaches the Earth.

_____

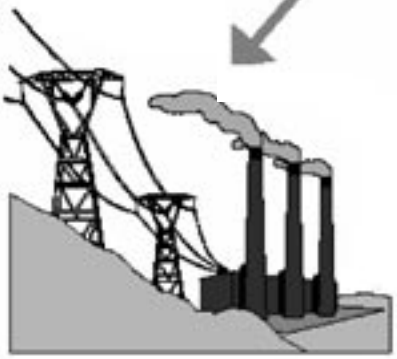
Plants absorb light energy and use it to make sugar. They use some of the sugar to live and grow. The rest is stored.

_____



Sometimes plants die and are buried under dirt and sediments. Over millions of years sediments build up and press down on the plants. Heat and pressure "cook" ancient plant remains into petroleum, coal or natural gas. We call these substances fossil fuels because they are formed and contain energy from plants that lived and died millions of years ago.

_____



Inside a power plant, fossil fuels are burned to heat water and produce steam. This steam is used to turn turbines. The turbines turn a large magnet inside a generator. A coil of copper wire surrounds the magnet. The spinning magnet causes the electrons in the wire to start to flow.

_____

_____

_____

Transmission lines carry lots of electricity from the power station to electric poles. Distribution lines bring small amounts of electricity from electric poles into our homes and businesses.

_____

Electricity flowing through a light bulb "excites" the atoms in a special piece of wire called a filament. These "excited" atoms glow, giving off light energy (heat is also produced).

_____

Alternative Energy

An alternative source of energy is considered to be any energy source other than the traditional fossil fuels such as coal and oil. Alternative sources of energy can be used for any type of energy requirement, but are mainly used as an energy source for transportation. Alternative energy sources are also called "renewables" because most of them are made from sources of which the Earth has an infinite supply. These alternative fuels promise to reduce dependence on foreign oil and minimize environmental impacts associated with fossil fuels.

Read the chart titled "Alternative Energy Sources" on page 9. Based on the information provided, respond to questions number 1 through 5.

1. Alternative energy sources offer an alternative to which of the following:

a. Fossil Fuels
b. Solar Energy
c. BioFuels
d. Ethanol

2. Alternative energy sources are mainly used for what?

a. Heating
b. Industry
c. Transportation
d. Agriculture

3. Most alternative energy sources are called renewables because...

a. they are infinite in supply
b. they are not infinite in supply
c. they are expensive
d. all of the above

4. Which alternative energy source can be created through the process of electrolysis?

a. Hydrogen
b. Diesel
c. Solar Energy
d. Ethanol

5. Which of the following is NOT an alternative energy source?

a. Hydrogen
b. Diesel
c. Solar Energy
d. Ethanol

Online Resources:
U.S. Department of Energy, Alternative Fuels Data Center
www.afdc.doe.gov/

U.S. Environmental Protection Agency, Alternative Fuels
www.epa.gov/otaq/consumer/fuels/altfuels/atlfuels.htm

U.S. Department of Energy
National Renewable Energy Laboratory
www.nrel.gov/

Alternative Energy Sources

ALTERNATIVE ENERGY TYPE	DEFINITION
NATURAL GAS	Made up of 95% methane and 5% various gases. Comes in three forms: the low-pressure form you use to cook or heat your home; Compressed Natural Gas (CNG), which is gas under high pressure; Liquefied Natural Gas (LNG), which is made by refrigerating natural gas to condense it into a liquid.
LIQUIFIED PROPANE GAS (LPG)	Mostly made up of propane and other similar types of hydrocarbon gases which are in gaseous form at room temperature, but turn to liquid when they are cold; *non-renewable*.
BIOFUELS	Fuels derived from alcohols, ethers, esters, and other chemicals made from biomass (includes herbaceous and woody plants, agricultural and forestry residues, and a large portion of municipal solid and industrial waste). **Types of BioFuels:** Methanol (M85 or M100)- sometimes called wood alcohol because it can be made from various biomass resources like wood. Ethanol (E85 or E100) - sometimes called grain alcohol because it is generally made in the U.S. from corn (a grain) but can also be made from agricultural crops and trash.
HYDROPOWER	Flowing water (hydropower) creates energy that can be captured and turned into electricity; currenty the largest source of *renewable* power, generating nearly 10% of the electricity used in the United States; can be stored in batteries.
HYDROGEN	Easy to produce through electrolysis, simply splitting water (H_2O) into oxygen and hydrogen by using electricity - however, at this time, nearly all hydrogen is made from natural gas.
WIND	Wind "energy" describes the process by which the wind is used to generate mechanical power or electricity - wind turbines convert kinetic energy in the wind into mechanical power.
SOLAR	Energy that is derived from the sun to generate electricity - heat from sun's rays is often collected and stored in photovoltaic cells.

Alternative Fuel Vehicles

What is an Alternative Fuel Vehicle (AFV)?

An alternative source of energy is considered to be anything other than gasoline, oil, and coal. Many altemative energy sources can be classified as fuels, which are used for general electricity needs and transportation. Vehicles that use alternative fuels are known as *alternative fuel vehicles or AFVs*. Read the paragraphs below and complete research on companies that manufacture alternative fuel vehicles. Students should make a list with a detailed description of vehicle make and model, type of fuel used, mileage range and environmental benefits.

Alternative Fuel Vehicles and the Environment

The use of alternative fuel vehicles not only decreases our dependence on foreign oil sources, but also provides numerous environmental benefits. Most notable is the reduced release of carbon monoxide (CO) and carbon dioxide (CO_2) emissions.

Gasoline and diesel powered motor vehicles give off emissions not only from the tailpipe, but during other phases of normal operation such as refueling. Even while parked, there are emissions from vehicles that contribute to the formation of ground-level ozone (Remember: *Ozone is Good up High and Bad Nearby!*). One solution to these problems is reducing vehicle use by making more responsible transportation choices. Unfortunately, the evidence suggests that people are not always likely to give up the convenience of their cars. It appears that the most reasonable option is to promote less polluting, more efficient cars - alternative fuel vehicles offer that option.

The use of motor vehicles for transportation accounts for approximately two-thirds of all U.S. petroleum use and is responsible for more than one-quarter of the greenhouse gas emissions, which have been linked to global warming. In Southeast Florida, motor vehicles account for nearly 50 percent of all air pollution. In order to protect our air quality, we need to make more responsible transportation choices, as well as utilize available alternative fuels and alternative fuel vehicles.

There are many types of AFVs:
Electric
Compressed Natural Gas (CNG)
Propane
Biodiesel
Hybrids

Research alternative fuel vehicles by visiting the following web sites:

- U.S. Department of Energy, Alternative Fuel Data Center at ***www.afdc.doe.gov***
- U.S. EPA Green Vehicle Guide at ***www.epa.gov/greenvehicles***
- ACEEE's Green Book at ***www.greencars.com***
- Department of Planning and Environmental Protection, Air Quality Division at ***www.broward.org/air***

Alternative Fuel Vehicles

What is an alternative fuel vehicle?

Read the article presented on page 10 and respond to the questions below by filling in the blanks.

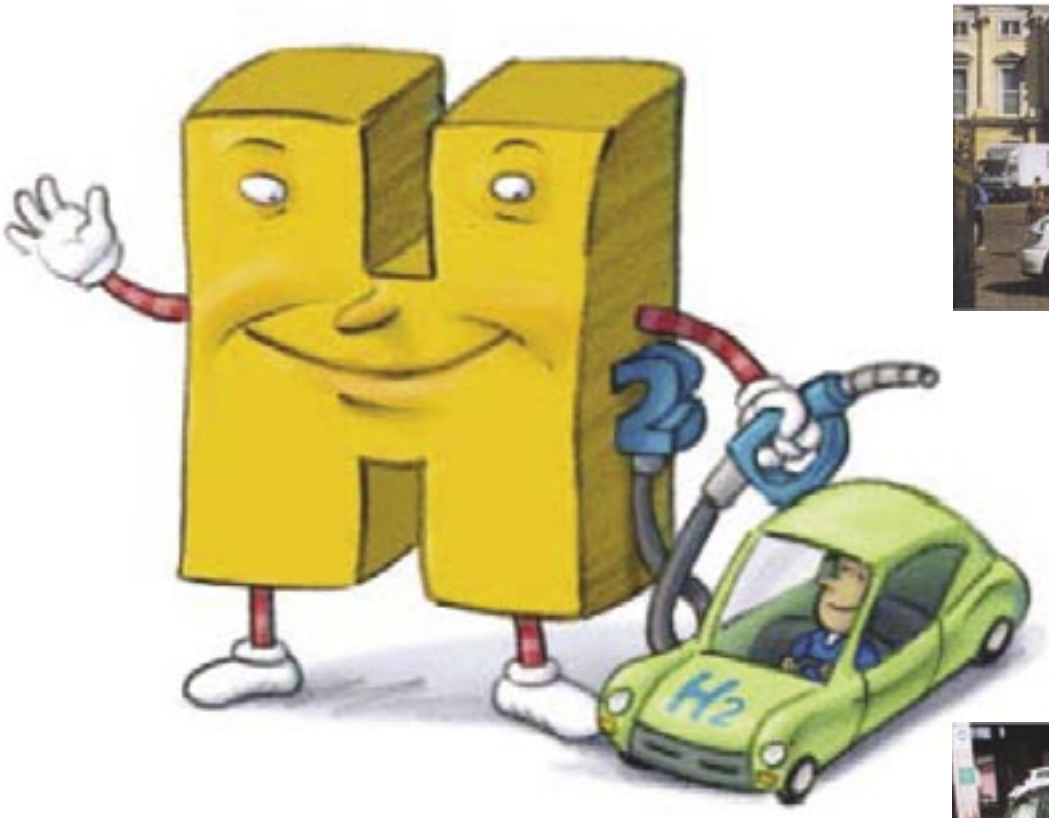
1. The most notable environmental benefit of alternative fuel vehicles is the reduction of _____ (CO) and _____ (CO_2) emissions.

2. Gasoline and diesel powered motor vehicles give off _____ not only from the tailpipe but during other phases of normal operation such as _____, and even when the car is _____.

3. The use of motor vehicles for transportation accounts for approximately _____ of all U.S. petroleum use and is responsible for more then _____ of the greenhouse gas emissions which have been linked to global warming.

4. In Southeast Florida, motor vehicles account for nearly _____ % of all air pollution.

5. Three types of alternative fuel vehicles are: _____, _____, and _____.

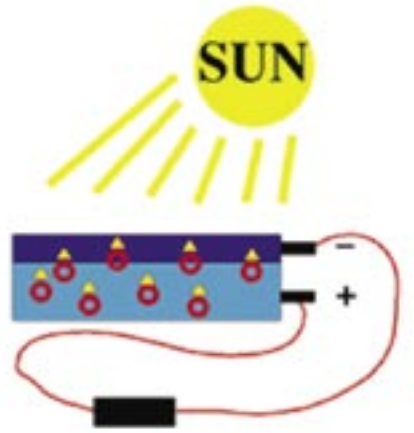


Sun Power: Learning About Solar Energy

Solar power derives its energy from the sun. The sun is our nearest star and without it, life would not exist on our planet.

Humans have used the sun's energy as far back as we have existed on this planet. We use the sun's energy every day in many different ways. When we hang laundry outside to dry in the sun, we are using the sun's heat to do the work of drying our clothes. Plants use the sun's light to make food. Animals eat plants for food.

One way to capture the sun's energy is to use solar cells or *photovoltaic cells* (PV cells). These can be found on many small appliances like calculators, and even on spacecraft. They were first developed in the 1950s for use on U.S. space satellites. They are made of silicon, a special type of melted sand. When sunlight strikes the solar cell, electrons (red circles) are knocked loose. They move toward the treated front surface (dark blue color). An electron imbalance is created between the front and back. When the two surfaces are joined by a connector, such as a wire, a current of electricity occurs between the negative and positive sides. These individual solar cells are arranged together in a PV module and the modules are grouped together in an array. Some of the arrays are set on special tracking devices to follow sunlight all day long.



The electrical energy from solar cells can then be used directly. It can be used in a home for lights and appliances. It can be used in a business. Solar energy can be stored in batteries to light a roadside billboard at night, or the energy can be stored in a battery for an emergency roadside cellular telephone when no telephone wires are around.

Reading Comprehension:

Read the article titled "Sun Power" and answer the following questions:

1. Solar energy is energy derived from the:
   a. moon
   b. soil
   c. sun

2. One way to capture the sun's energy is to use _____.
   a. traps
   b. PV cells
   c. a solar oven

3 True or False: Solar energy can be used to power lights and appliances.
_____.

4. One advantage of using solar energy rather than fossil fuels:
   a. it is an inexhausitable form of energy.
   b. it can be captured by solar cells and used directy for electrical energy.
   c. both a & b

Source: Foundation for Water and Energy Education

Hydrogen Fuel Cells: Clean, Alternative Energy

WHAT IS HYDROGEN?

Hydrogen is the simplest known element. An atom of hydrogen has only one proton and one electron. It is also the most plentiful gas in the universe.

The sun's energy comes from hydrogen. The sun is a giant ball of hydrogen and helium gases. Inside the sun, hydrogen atoms combine to form helium atoms. This process — called fusion — gives off radiant energy.

This radiant energy sustains life on earth, it gives us light and makes plants grow. It makes the wind blow and rain fall. It is stored in fossil fuels. Most of the energy we use today came from the sun.

Hydrogen as a gas (H_2) doesn't exist on earth. It is always mixed with other elements. Combined with oxygen, it becomes water (H_2O). Combined with carbon, it makes different compounds such as coal and petoleum. Hydrogen is also found in biomass, or all growing things.

HYDROGEN CAN STORE ENERGY

Renewable energy sources — like solar and wind — can't produce energy all the time. The sun doesn't always shine. The wind doesn't always blow. Renewables don't always make energy when or where we need it. Hydrogen can store energy until it's needed and move it to where it's needed.

HYDROGEN AS AN ENERGY CARRIER

Every day we use more energy, mostly coal, to make electricity. Electricity is a secondary source of energy. Secondary sources of energy — sometimes called energy carriers — store, move, and deliver energy to consumers. We convert energy to electricity because it is easier for us to move and use.

Electricity provides the power for us light, heat, hot water, refrigerated food, TVs, and computers. Life would be really hard if we had to burn the coal, split the atoms, or build our own dams. Energy carriers make life easier. Hydrogen is an energy carrier for the future, it is a clean, renewable fuel that can be used in places where it's hard to use electricity. Sending electricty a long way costs four times as much as shipping hydrogen by pipeline.

Hydrogen Fuel Cell

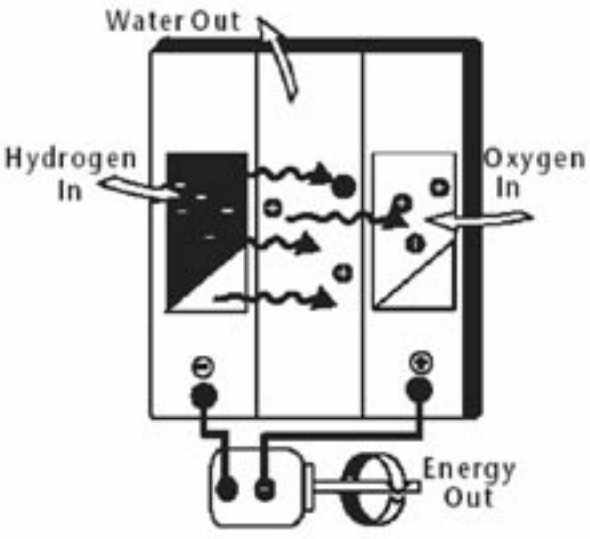


Image: www.eere.energy.gov/hydrogenandfuelcells/pdfs/hydrog1a.pdf

Hydrogen Fuel Cells: Clean, Alternative Energy

HYDROGEN CAN STORE ENERGY

Most of the energy we use today comes from fossil fuels, only seven percent comes from renewable energy sources. But people want to use more renewable energy. It is usually cleaner and is replenished in a short period of time.

HOW IS HYDROGEN MADE?

Since hydrogen doesn't exist on earth as a gas, we must make it. We make hydrogen by separating it from water, biomass, or natural gas. Scientists have even discovered that some algae and bacteria give off hydrogen. It's very expensive to make hydrogen right now, but new technologies are being developed all the time.

USES OF HYDROGEN

NASA has used hydrogen for years in the space program. Hydrogen fuel lifts the space shuttle into orbit. Hydrogen batteries — called fuel cells — power the shuttle's electrical systems. The only by-product is pure water, which the crew uses as drinking water. Hydrogen fuel cells (batteries) make electricity. They are very efficient, but expensive to build. Someday, small fuel cells could power electric cars. Large fuel cells could provide electricity in remote areas.

HYDROGEN AS A FUEL

Because of the cost, hydrogen power plants won't be built for quite a while. Hydrogen may soon be added to natural gas, though, to reduce pollution from existing plants. Soon hydrogen will be added to gasoline to boost performance and reduce pollution.

Adding just five percent hydrogen to gasoline can lower emissions by 30 to 40 percent. An engine that burns pure hydrogen produces almost no pollution. It will probably be 20 years, though, before you can walk into your local car dealer and drive away in a hydrogen-powered car. Hydrogen would also be a great jet fuel. It's high in energy, so jets would need less fuel. And it weighs less than the fuel used today, so jets could carry more cargo. It's also non-polluting. If the price of jet fuel continues to rise, you might see planes converting to hydrogen in the near future.

THE FUTURE OF HYDROGEN

Before hydrogen can take its place in the U.S. energy picture, many new systems must be built. We will need systems to make hydrogen, store it, and move it. We will need pipelines and fuel cells. And consumers will need the technology and the education to use it. The goal of the U.S. Department of Energy's Hydrogen Program is for hydrogen to produce 10 percent of our energy by the year 2030. Hydrogen could provide clean, renewable energy for the future.

Source: DOE www.eere.energy.gov/hydrogenandfuelcells/pdfs/hydrog1a.pdf

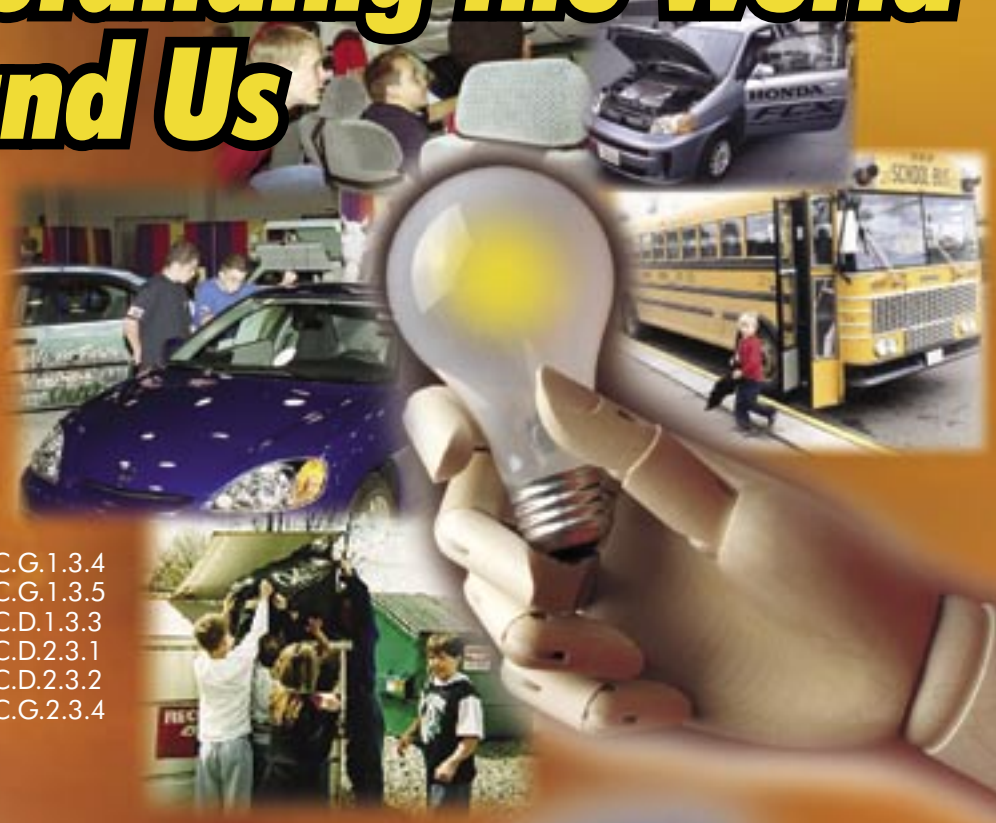
WRITING PROMPT

Persuasive:
Writing situation: Hydrogen fuel can be used to meet future energy demands.

Directions for writing:
Read the article on hydrogen fuel found on pages 13 & 14. Based on the information presented, write an essay that persuades the reader hydrogen fuel will be a good alternative to fossil fuels.

ECOLOGY:

Understanding the World Around Us



Standard 1, Benchmark SC.G.1.3.4
Standard 1, Benchmark SC.G.1.3.5
Standard 2, Benchmark SC.D.1.3.3
Standard 2, Benchmark SC.D.2.3.1
Standard 2, Benchmark SC.D.2.3.2
Standard 2, Benchmark SC.G.2.3.4

Ecosystems: The Fabric of Life

What is an ecosystem?

An ecosystem is the system of interactions between living organisms and their environment. Components of an ecosystem are like separate threads which, when woven together, result in a piece of fabric much larger and stronger than each strand is by itself. Indeed, an ecosystem – like a piece of fabric – is so closely woven together that if one strand is damaged or removed, the entire cloth can begin to unravel.

Ecosystems are made up of both living *biotic* and non-living *abiotic* components. Abiotic components include things such as minerals, climate, soil, water and sunlight. Two major forces weave together the living and non-living components of an ecosystem: the flow of energy and the cycling of nutrients. In almost all ecosystems the sun is the source of energy. Energy and nutrients flow from organism to organism by way of the food chain.

Because the complex and sometimes fragile relationships between organisms and their environment provide us with a wealth of scientific information, the study of ecosystems is instrumental in assessing and controlling environmental effects of agricultural development and industrialization.

Read the article titled "The Everglades Story" on page 18. Then answer questions 1 through 5.

1. Marjory Stoneman Douglas, a famous Florida environmentalist, wrote a book titled *The Everglades: River of Grass*. She called it *the river of grass* because:
    a. Many people planted grass in the Everglades.
    b. An unusual plant called sawgrass grows throughout much of the Everglades.
    c. Water flowing through the Everglades often carries grass cuttings from nearby lawns.
2. In what way(s) is the present day Everglades system different from that of the past?
    a. The Everglades is no longer a free-flowing river.
    b. Today, 1,400 miles of canals drain most of the shallow river.
    c. Both a & b
3. How can human release of water into the Everglades impact wildlife populations?
    a. Too much water being let into the Everglades during winter dry season can make it hard for wildlife to find food. This can lead to a decrease in the numbers of wildlife.
    b. Too little water being let into the Everglades can make it hard for wildlife to find water. This can lead to a decrease in the numbers of wildlife.
    c. Both a & b
4. Why is the quality of water entering the Everglades a concern for scientists?
    a. The water has been found to contain high amounts of fertilizers.
    b. The water has been found to contain no nitrogen.
    c. The water has been found to contain sawgrass.
5. One of the greatest threats to the survival of the Everglades National Park is the increasing demand being placed on a limited supply of:
    a. Pollutants
    b. Clean water
    c. None of the above

Ecosystem Management: Focus on SFWMD

South Florida Water Management District (SFWMD) operates and maintains 1,800 miles of canals and levees, 25 major pumping stations and about 200 larger and 2,000 smaller water control structures. The District spans 16 counties with a total population of more than six million residents in central and southern Florida. The agency provides flood control protection and water supply protection to residents living and working in cities or on farms within this region, and is working to restore and manage ecosystems from the Kissimmee River to the Everglades and Florida Bay.

The Everglades Water Story

Past Everglades

To understand the Everglades today, you must first understand what it was like in the past — before humans changed it. Most people do not realize that the Everglades is actually a river system. Marjory Stoneman Douglas, a famous Florida environmentalist, tried to teach people this concept in her book, *The Everglades: River of Grass*. She called it the river of grass because throughout much of the shallow river grew an unusual plant called sawgrass. In some areas, you could barely see the water because the sawgrass was so dense.

The story of the Everglades river begins near Orlando and Disney World. There, the rainfall and springs filled lakes and creeks. The water emptied into the Kissimmee River which, in turn, emptied into Lake Okeechobee. When Lake Okeechobee was filled, water flowed out into small streams at the south end of the lake. It spread across the wide open flat land in a shallow sheet of slow moving water (up to ¼ -½ mile, or 600 meters, per day). The Everglades river was born!

The Everglades river was a few inches deep, but up to 50 miles (80 km) wide and 100 miles (160 km) long, ending its journey in the Gulf of Mexico. There, the shallow river mixed fresh water with salt water to create a brackish water estuary, rich with marine life such as shrimp, lobster, crab, and fish. The Everglades river, or wetland, was once home to millions of creatures. It was perhaps best known as the home to the American alligator and huge flocks of wading birds, by some accounts numbering up to 2.5 million at one time. Fish, turtles, alligators, and other water species were abundant. They provided a source of food for the Seminole and Miccosukee Indians who lived in the Everglades. Because the Indian population was small, what they took from the Everglades was not harmful.

Present Day Everglades

Today, the Everglades is no longer a free-flowing river. The only part that truly resembles this "original Everglades river" is one-tenth of the original wetland now found in Everglades National Park. When white settlers came to South Florida, they viewed the Everglades as a wasteland. They began to drain the land to create dry areas for farming and their homes. Today, 1,400 miles of canals drain most of the shallow river. A dam now holds back water from Lake Okeechobee. The areas south of the big lake grow thousands of acres of sugar cane. Near Miami, thousands of acres of pinelands were destroyed to grow tomatoes and other crops. Today, thousands of gallons of water are used to irrigate these newly created agricultural lands. Three huge reservoirs, or "human-made" lakes called water conservation areas, trap most of the Everglades water and have turned it into shallow lakes, rather then a river of grass. Dams were built along the edge of these areas to move water in time of drought, and thus prevent flooding in cities along the east coast of Florida. They also serve to recharge fresh water well fields as the river had done in the past. Some of the water from the water conservation areas is allowed to flow into Everglades National Park. On occasion, water is let into the park by opening the dams, called "flood gates," along the Tamiami Trail.

Scientists and other staff at Everglades National Park are trying to recreate conditions of the original Everglades river. They want the water to flow across the land into the Gulf of Mexico as nature would have allowed naturally.

Water Quantity

The Everglades river or wetland provides water, food, shelter, and space for all of the creatures that live there. The river of grass is not very deep. All of the organisms have evolved over thousands of years to live in the river. During the winter dry season, the river slows to a trickle. Many areas dry up except for the alligator holes and channels, called sloughs. There, fish are trapped in large numbers – providing easy meals for alligators and birds. At this time of the year, many birds would nest because food would be plentiful for their young.

Since the early 1960s, however, human release of water into the park has not always copied what "mother nature" would have done. Too much water being let into the park during the winter dry season can make it hard for wildlife to find food, while too little can make it hard for them to find water. Both lead to a decrease in the numbers of wildlife.

Water Quality

Scientists and rangers at Everglades National Park are also concerned with the quality of the water being let into the park from water conservation areas. These areas contain water that has flowed through large agricultural areas. This water contains high amounts of fertilizer. Water, rich in fertilizer containing nitrogen and phosphorus, can change the types of plants living in the water and, ultimately, the food chains found there. There is serious concern that polluted water entering Everglades National Park could cause natural periphyton and sawgrass to be replaced by other plants, thus altering this last natural remnant of the original Everglades.

The Everglades Today - Why Should You Care?

The Everglades "ain't what it used to be" as old timers might say, and neither is South Florida. In 1991, with continued population growth and the agricultural industry's impact on water quality and quantity, the greatest threat to the survival of Everglades National Park is the increasing demand being placed on a limited supply of fresh clean water. Water that flows from your faucet at home would have been a part of a huge Everglades system years ago. Today, only a small fragment of that system exists as Everglades National Park. Unless the park gets the water it needs, the last remnant will not survive. Water conservation and better management of urban growth appear as two logical solutions to this problem. If the proposed solutions are not practiced, we could expect to lose several things:

1. We would lose a natural recharge system for well fields in extreme South Florida. Salt water will pollute wells as it seeps into them from the ocean. Drinkable fresh water will become more difficult and more costly to find.

2. Marine species may not survive well in Florida Bay. If the bay becomes too salty because of a lack of fresh water, shrimp, lobster, crab, and fish populations may decline dramatically throughout South Florida and the Florida Keys. The cost for scarce seafood would sky rocket!

3. Last, but not least, without water for the Everglades, many species would leave the area or die. This would make our lives unstable and a little less rich. Each time a species becomes extinct, we lose a source of potential medicine, food, beauty, inspiration, and a fellow passenger of spaceship earth.

Please be careful when you use water. Conserve it! Don't waste it! We all can have an impact on the survival of the Everglades.

Source: www.nps.gov

Recycling: Making the Most Out of Things

As our population increases, our demands on natural resources are intensified. Not only have government leaders become concerned with providing enough goods and services to the growing numbers of residents, but they also must contend with the rapid production of waste.

One method to manage solid waste that has gained popularity over the last 40 years is recycling. Recycling saves both raw materials and energy. It reduces the amount of waste that needs disposal and is a vital alternative in coping with a shortage of existing landfill capacity.

The campaign to recycle has reinforced three principal actions referred to as the 3 Rs: *reduce, reuse, recycle*. Choosing products made with recyclable or less packaging helps *reduce* solid waste. Purchasing refills and reusing the original containers is one way to *reuse*. Depositing recyclables, such as paper or plastic, for collection supports *recycling* programs. Through mindful use of our natural resources, and support of environmentally friendly waste management techniques, we can help minimize our impacts on the environment.

The first step in creating change is to become educated on the problems, as well as the solutions. Broward County's Office of Integrated Waste Management (OIWM) is responsible for safely managing waste from the community. To learn more about recycling, visit OIWM online at ***www.broward.org/oiwm*** or call ***954-765-4999***.

For additional information on how you can become a more active environmental resident, visit the Department of Planning and Environmental Protection online at ***www.broward.org/dpep*** or call ***954-519-1220***.

Take Your Learning One Step Further and Complete the Activity:

What's In Our Trash

Found online at www.broward.org/aqi03971.pdf

Did You Know...

A **waste-to-energy** plant turns garbage into electricity! Each year, the plants generate enough electricity to service about 120,000 households in our community at an energy savings of 2.8 million barrels of oil.

Waste-to-energy plants are helpful in managing Broward County's solid waste. It is estimated that in one year, the amount of solid waste processed at waste-to-energy plants could fill the area of a football field up to 3½ miles high! To learn more, visit *www.broward.org/iwi02200.htm*.

PHYSICS:

Motion & Forces

Standard 1, Benchmark SC.B.1.3.1
Standard 1, Benchmark SC.B.1.3.4
Standard 1, Benchmark SC.G.2.3.1
Standard 2, Benchmark SC.C.2.3.6
Standard 2, Benchmark SC.H.2.3.1

Laying Down the Law: Newton's Laws of Motion

Newton and His Forces

Sir Isaac Newton was born on Christmas day in 1642. In that same year another famous scientist, Galileo, died. Together, Galileo and Newton's scientific ideas changed all of science. They ended traditions that dated back more than a 1,000 years to the Greek philosopher Aristotle.

Aristotle believed that the natural state of any object was to be at rest. In addition, he said that an object would constantly work toward reaching that state. Both Galileo and Newton disagreed. Galileo developed an idea that any object resisted any change in its motion. He called this phenomenon *inertia*. Newton went even further, saying that an object's motion would not change unless a force acted on it.

Newton's Three Laws

1. An object at rest will remain at rest, or an object moving in a straight line at constant speed will continue to do so until a force acts on it.
2. An object that has a force acting on it will accelerate in the direction of the force.
3. Forces always occur in equal but opposite pairs.

Source: Glencoe/McGraw-Hill, a division of The McGraw-Hill Companies, Inc.

Thinking Critically

Using your knowledge of Newton's laws of motion, explain the following:

1. Bumper cars are an example of Newton's third law. Explain

_____

_____

_____

2. A roller coaster is a good example of more than one of Newton's laws of motion. Explain.

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Magnetism and Electricity

FACT #1

Magnetism is the force by which objects are attracted to other objects or repelled by other objects. Magnets have two opposite ends, called poles. The north pole of one magnet will repel or push away the north pole of another magnet. The same thing will happen with two south poles. However, the north pole of one magnet will attract or pull toward the south pole of another magnet. Just like people say about some boyfriends and girlfriends, "opposites attract."

FACT #2

Magnets get their name from Magnesia, a place in Asia where lodestones were found in ancient times. Lodestones were the first known magnets. They are rocks containing iron that have become permanently magnetized. We call permanent iron magnets like these ferromagnetic (*ferro-* is a prefix that means "iron").

FACT #3

Most iron is not permanently magnetic, but it can be made into a temporary magnet. The reason this is possible has to do with the electrons that make up the iron atoms. When the electrons are lined up just right, the piece of iron becomes a temporary magnet.

FACT #4

Magnetism involves electrons and electricity. This is a complicated topic. Scientists in this field study things like physics, electromagnetic theory, and quantum mechanics. All of these topics depend on advanced mathematics, so if you want to really get into magnetism someday, keep doing your math homework.

FACT #5

Electricity is often used to make one type of magnet, called an electromagnet. Electromagnets are made from copper wire coiled around a core. Iron placed inside the core makes the magnet stronger. When an electric current is sent through the coiled wire, the wire becomes magnetized. When the current stops, the magnetism stops too.

TID BIT

A great advantage of electromagnets is that you can shut them off! Huge electromagnets are used to pick up scrap iron in a junkyard. After the scrap metal is moved to its new location it can be dropped by turning off the electromagnet. Electromagnets are also an integral part of such useful devices as electric motors, buzzers and doorbells, solenoid switches, telephones, transformers, and loudspeakers.

Source: Sharon Fabian at www. edhelper. com/ReadingComprehension_27_10.html

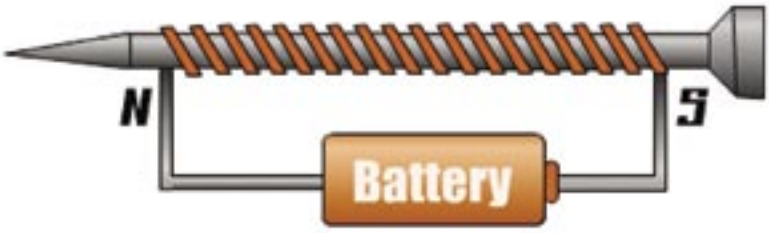
Making an Electromagnet*

Materials:

Large iron nail
Five feet of about 22 gauge copper wire insulated with enamel
"D" alkaline battery
Sandpaper
Tape
A few paper clips

Procedure

1. Measure off a 6-inch piece of wire.
2. Slowly and carefully wrap the wire around the iron nail in a neat row.
3. When you've covered about three-fourths of the nail, start back the other way. The tighter you wind the wire and the more times you wind around the nail, the stronger your magnet will be.
4. Use your sandpaper to scrape off the enamel insulation on the ends of the wire. This will expose the wire so you can hook it up to the battery.
5. Tape one of the wire ends to the bottom end of the battery.
6. Touch the other wire end to the bump on the top of the battery and -- ***Zaloom!*** -- your very own electromagnet. Use it to pick up your paper clips. When you remove one of the wire ends from the battery, your magnet will let go of the paper clips.
7. BE CAREFUL! If you leave the wire ends connected to the battery for more than a few seconds, the wire will become very hot! And you'll wear out the battery very quickly.



*Source: Beakman's World at www geocities.com/TelevisionCity/Set/4567/elecex.htm

Answer Key

PAGE 7

Nuclear energy in core of sun,

Radiant energy traveling through space,

Chemical energy stored in plants,

Chemical energy stored in fossil fuels,

Thermal energy from burning fossil fuels,

Mechanical energy in turning turbines and generator,

Electrical energy in wire,

Electrical energy coming into homes,

Radiant energy lets us see light.

PAGE 8

1. a
2. c
3. a
4. a
5. b

PAGE 11

1. carbon monoxide, carbon dioxide
2. emissions, refueling, parked
3. two thirds, one quarter
4. 50%
5. answers will vary

Page 12

1. c
2. b
3. true
4. c

PAGE 15

Answers will vary

PAGE 17

1. b
2. c
3. c
4. a
5. b

PAGE 22

Answers will vary

ScienceFest

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